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SMART DATA COMMUNICATION SOLUTIONS FOR SMALL SATELLITES

Abstract

Data Communication and data handling system in an electronic system design has analogy of blood circulation in every human system. If the system is well designed, robust communication channel can be achieved. The main constraint in the design of small satellites is the available space. AraMiS satellite employs a novel design approach, based on tiles, which is quite flexible and modular. A number of sensors, actuators and other small modules are present on every tile using a plug and play approach. The communication of housekeeping data of different sensors within a tile and across the tiles, managed by onboard computer, can either be done using wired approach or wireless approach. This work focusses on data communication solutions using wireless approach. Two types of communications systems have been tested onboard AraMiS, infrared optical and Radio Frequency based.

The optical communication system largely consists of electronic and optical components. The input data stream from any module is sent through encoder, driver and IRLED at the transmit side and data is available at receive side through photo-detector, amplifier and comparator stages. The channel used for communication can either be FSO or glass fiber. An innovative design of placing glass fiber for reliable communication across the tiles has been discussed. The optical light has been guided in certain directions using double surface mirrors. Theoretical and measurement results are in close comparison with each other. Every tile hosts two tiles processors (MSP430 controllers), responsible for communication across different nodes.

After much literature review, radio frequency communication system has been developed using TI CC2510 and CC1110 transceiver modules. The protocol stack has been kept compliant with propriety simpliciTI protocol. The receive signal strength for different variable power levels have been computed and plotted. The packet format for the receive packets has been detected using a commercial packet sniffer software and the received packets from different radio transceivers have been received with a very small packet error rate. We are able to transmit packets with output transmit power as low as upto -30dBm with acceptable average RSSI.

A complete mapping strategy for wireless communication protocols has been formed considering the limited communication channels available onboard the small satellites.All the possible communication systems have been made complaint with the basic protocol of the AraMiS so that the end user is able to use them without knowing much detail about the physical layer of each protocol.